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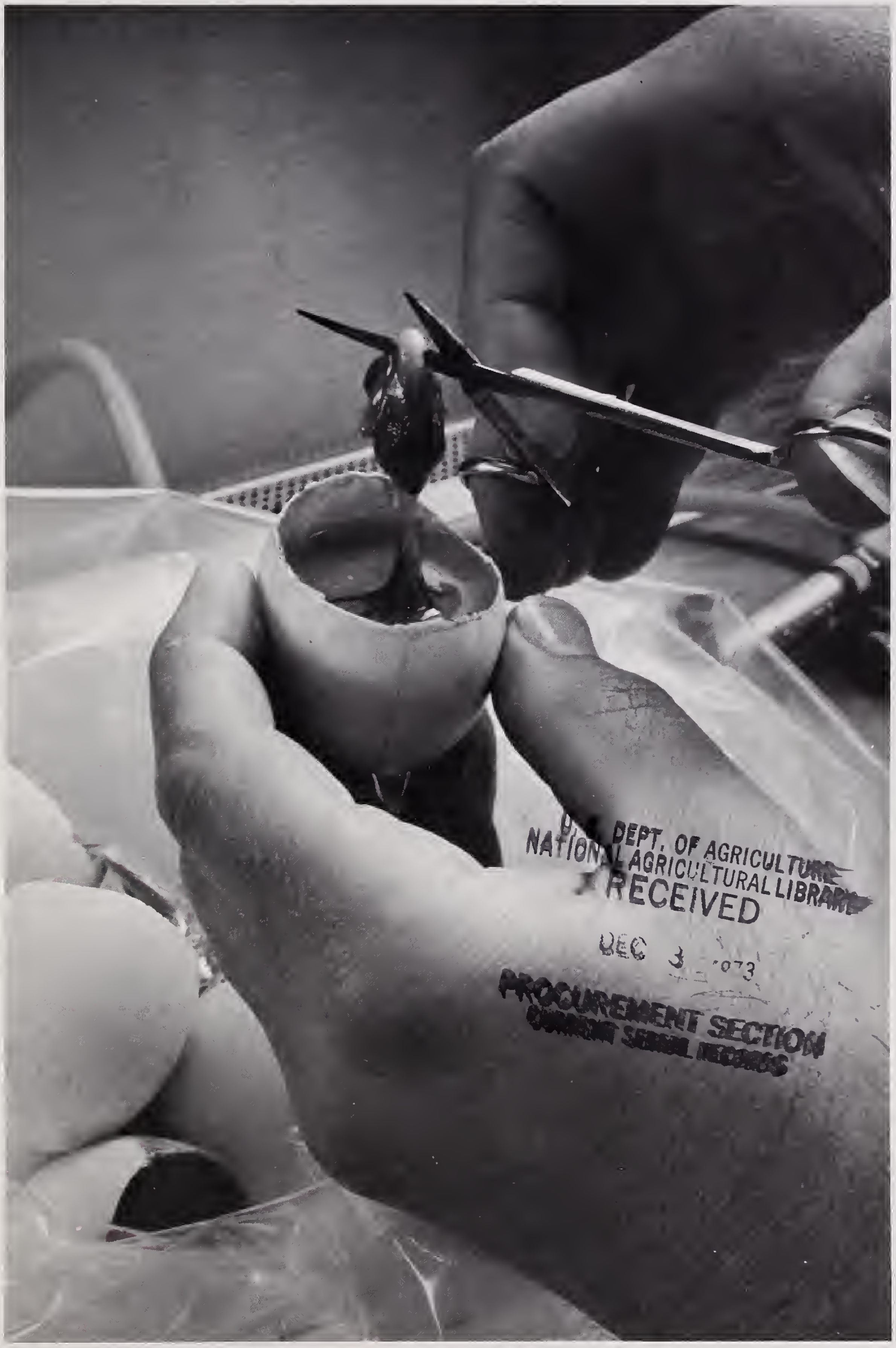
U.S.DEPARTMENT OF AGRICULTURE NOVEMBER 1973



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November 1973/Vol. 22, No. 5

Stately Monarchs

Legends tell us that when the Druids worshiped in the groves of the "Oaks of God" men believed that trees had souls. Modern man, perhaps stirred by dim ancestral memories from the millennia when he was a gatherer of fruit, still cherishes the tree. In these pragmatic times, however, while we prize the beauty and utility of trees, we view them as living creatures that breathe, assimilate nutrients, grow, reproduce, and sustain stress and disease. Unfortunately, our increasingly urban civilization has drastically altered the ancient harmony of man and tree.

For industry and technology have greatly expanded the catalog of hazards that besiege trees of urban America. Along with those traditional and still most troublesome foes, insects and diseases, urban trees must contend with others: smog-laden air, compacted and droughty soil, road salt, reflected heat, the windy gusts of urban canyons, to cite a few. Moreover, we expect today's urban trees to meet certain standards. They must grow within bounds, stay out of underground pipes and sewers, avoid uprooting sidewalks, produce no objectionable fruits or seeds, and, above all—survive.

The quest for better and more enduring urban trees is underway. In field plot, greenhouse, and city street, ARS scientists are looking for well-shaped and vigorous trees of intrinsic value. Individual trees that pass the rigid standards for selection are propagated vegetatively by cuttings or grafting to build up a clonal population for field testing in varied climatic zones. When possible, the seedlings or clone of a single tree are also tested in the greenhouse for tolerance to air pollution and to salt in the soil. Many seedlings are also exposed to specific diseases, either in natural stands or by artificial inoculation.

In other research, scientists are developing hybrid trees. Their goal: incorporate traits for resistance from horticulturally undesirable species into better trees, hopefully producing a tree superior to either parent. Whether derived through selection or hybridization, it is vital to run tests over several years before releasing the offspring of superior parent trees to wholesale nurserymen and ultimately the public. The development of a new tree takes years. In time, however, science will give rise to stately new shade trees, the kind that blend building and earth and sky into an aesthetic whole, humanizing and enhancing the cityscapes of tomorrow.

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COVER: Duck embryos are used extensively in Marek's disease research. Here, 13-day-old duck embryos are processed for fibroblasts—the cells that give rise to connective tissue—in preparation for growing turkey herpesvirus as a vaccine. Scientists have learned that duck embryo cells make excellent growth media for both the virus causing Marek's disease, and the vaccine against the disease (0673A1220-2). See story, pages 7–11.

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), U.S. Department of Agriculture, Washington, D.C. 20250. Printing approved by the Office of Management and Budget through June 15, 1977. Yearly subscription rate is $2.50 in the United States and countries of the Postal Union, $3.25 elsewhere. Single copies are 30 cents. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Use of commercial names and brands is for identification only and does not imply endorsement or approval by USDA or ARS. Information in this magazine is public property and may be reprinted without permission. Credit will be appreciated but is not required. Prints of photos are available to mass media; please order by photo number.

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22(5): 3-4 Nov 1973

Epidemic forecast may save wheat

Dr. Eversmeyer, ARS plant pathologist, Manhattan, Kans., examines wheat plants for evidence of stem rust. Data collected on stem rust development and associated meteorological conditions for four seasons in wheat nurseries throughout the Great Plains were used in developing the equations for predicting rust severity (0673X1156–27).

A WAY to predict wheat stem rust epidemics is now under development. It is the missing element in a three-part system for minimizing yield losses from the disease.

Resistant and early-maturing wheat varieties are the major defenses against crop losses from wheat rusts. Repeatedly, however, the resistance of a widely planted variety has been breached by the appearance of new, virulent forms of the disease organism.

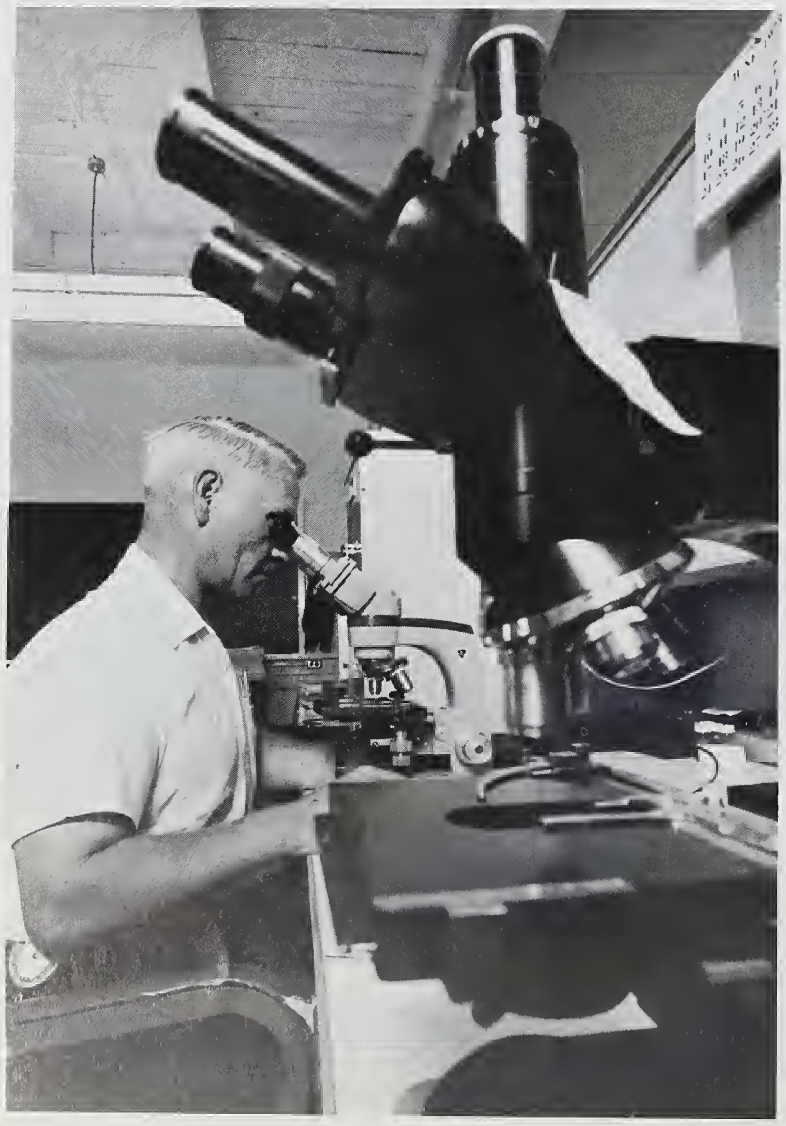
Available fungicides have some value in suppressing severe epidemics while new resistant varieties are being developed and distributed, and more effective ones are being developed (AGR. RES., Jan. 1973, p. 5). Wheat growers, operating on a small margin of profit, cannot afford to use fungicides except in epidemic years, and must apply them early to restrict buildup of the disease.

A reliable rust forecasting system, the goal of studies by a trio of plant pathologists in ARS and USDA's Animal and Plant Health Inspection Service (APHIS), would tell growers in advance when they need to use a fungicide. Merle G. Eversmeyer of ARS and James R. Burleigh, formerly of ARS, both at Manhattan, Kans., and Alan P. Roelfs of APHIS at St. Paul, Minn., employed a computerized technique to formulate equations for predicting the severity of stem rust 7, 14, 21, and 30 days after date of prediction.

The equations were tested using 1972 data from Manhattan. Scientists' predictions were within 15 percent of recorded severity, and were based on estimates made 30 days before the soft dough stage of wheat growth. If actual final severity was 45 percent, equations in their present stage of development would predict 30 to 60 percent.

After data on each of the variables are summed by the computer, Dr. Eversmeyer, at a calculator, enters data from computer printouts into an equation for predicting stem rust severity (0673X1155-10).

In laboratory, ARS technician Arthur Schulze, at the microscope, counts the spores from many pustules collected in the field on a rod spore sampler. Number of spores per square centimeter trapped in the 7 days before date of prediction is one of the variables used in the equations (0673X1155-18).



To develop the equations, the researchers collected data for four seasons on stem rust development and associated meteorological conditions. The data originated at wheat nurseries in the Great Plains, from Beeville, Tex., on the south to Crookston, Minn., on the north. Both resistant and susceptible varieties of winter and spring wheats were included.

The equations express in mathematical terms the relationship among variables in nature. Some of the variables used—disease severity on date of prediction, for example—have biological meaning. Others, such as the numerical code for nursery locations, do not. Still others express relationships between biological and meteorological conditions.

With each of the variables expressed as numbers, the scientists programmed the computer to construct the equation $Y = X_1 + X_2 + X_3 + X_4 \ldots$, in which Y is stem rust severity 7, 14, 21, or 30 days in the future, and a varying number of X values are the variables and their coefficients which together come closest to equalling the mathematical value of Y. The computer made repeated searches, each time entering into the equation the variable that contributed most to the mathematical value of Y and eliminating from analysis the variables that were not significant. This technique is known as stepwise multiple regression.

Six variables proved useful in constructing the equations. They are: percent stem rust severity on date of prediction (DP); number of stem rust urediospores per square centimeter trapped during 7 days before DP; cumulative number of urediospores per square centimeter trapped to DP; wheat growth stage on DP; an evaluation of favorability for infection each day between first observance of stem rust and DP; a similar evaluation for the 7 days before DP; and the variety being grown.

Dr. Eversmeyer and associates found that the same equations would predict stem rust severity in both winter and spring wheat but that separate equations were needed to predict leaf rust in the spring and winter wheat regions. "The rate of development and final rust severity can be estimated accurately when rust is present in the field on date of prediction," Dr. Eversmeyer reports. When it is not, present equations usually underestimate both.

"We believe that other variables or combinations of existing variables can be used to improve the accuracy of our predictions." Dr. Eversmeyer says, "and we should be able to increase the length of the forecast period from 30 days to 45 days or longer."

The stem rust organism seldom overwinters north of Denton, Tex. So Dr. Eversmeyer believes accuracy may be increased by including disease severity estimates or urediospore numbers in the area believed to provide inoculum for the location covered by the prediction. Research now underway will determine the value of including this information in the equations. □

Controlled traffic boosts cotton yields

MODERN FARM MACHINES literally crush the ground they ride on. They compact the soil and prevent roots from getting all the water and nutrients the plant needs for maximum growth.

ARS researchers at the National Tillage Machinery Laboratory (NTML), Auburn, Ala., cooperating with agricultural engineers at Auburn University, are testing machinery and methods for managing the pressure that machines exert on the soil so it interferes as little as possible with plant growth.

Soil scientist Albert C. Trouse explains the problem this way: "The tractor running up and down every row restricts lateral root development, while traffic soles at tillage depths make pans that restrict vertical development. So, instead of growing crops in 4- or 5-foot-deep soil, we're essentially farming in a window box—in a little strip 8 or 9 inches deep and 13 inches wide."

A partial solution to compaction, under investigation at NTML, is controlled traffic in the fields. Because soil prepared for a seedbed is most vulnerable to compaction, and unplowed, settled soil is only slightly compressed under traffic, the engineers believed that tillage could be done on permanent machine paths.

In field tests, traffic was restricted to pairs of interrows each year. Simply reducing the number of passes over the field isn't enough to eliminate damage since over 75 percent of the compaction takes place on the first machine pass over a seedbed.

When the soil was tilled to a depth of 18 inches to penetrate the plow sole, the engineers increased cotton yields by about a third of a bale per acre. Once traffic was allowed on the 18-inch-deep seedbed, the difference in yields dropped rapidly. Planting and cultivation were done with a wide front-end tractor using permanent traffic paths. In later tests with all variables except traffic kept constant, plots having controlled traffic produced an average of 3,411 pounds of seed cotton while plots with unrestricted traffic yielded only 2,845 pounds—a difference of almost 20 percent in favor of controlled traffic.

Controlled traffic tests at NTML have been conducted on sandy loam soil, a poor yielding soil where a good farmer with conventional practices will make about 1¼ bales an acre. Average yield runs four-fifths bale per acre.

Where the pan was removed and the tractor wheels traveled the area between each row (the interrow) on 2 by 1 skip row cotton, the yield was 2 bales per acre. Where the wheels on a wide tractor axle did not travel the interrows, but instead traveled in the skips to give a good 40-inch-wide root bed, the yield was 2½ bales per acre.

"Today, we're wasting money on plowing," Dr. Trouse says. "We plow some 350 million acres across the United States and then recompact two-thirds of it so that it's unsuited for good root development. This is just like wasting two-thirds of the money spent on tillage."

Tractors have to be used for heavy jobs in the field, such as rotary tillage or plowing. For lighter cultivating, spraying and planting jobs, Dr. Trouse envisions a light, self-propelled frame that could straddle 10 or more rows. Some 8-feet long, it would have wheels on each side that turn 90 degrees, enabling it to travel lengthwise down a paved road.

How about managing soil compaction now? "I think we can do it with a standard 80-inch-wide tractor," Dr. Trouse says.

"Use a 4-wheel tractor, not a tricycle type, and make the wheels ride the same interrows each time they go through the field. Make sure they don't ride in a row they haven't ridden in before, and keep these roadways to a minimum in each field," he concludes. □

*Above: The root system is confined on the sides by compacted soil in the interrows and by the plowsole on the bottom. Note poorer root distribution in the harrowsole or first layer below the surface (PN–2842). **Below:** This is soil profile showing root distribution in a pierced plowsole—no controlled traffic strip (PN–2843).*

Precision planter gives beans a head start

A GROWTH PHENOMENON of bean seeds could make precision planting very valuable to large commercial vegetable growers.

Most seeds planted randomly must turn to emerge if the stem end is not pointed toward the surface. Some seeds, if the hypocotyl—stem end—is down, must rotate 180 degrees as they begin their trek to the surface.

A precision planter developed by ARS researchers in Kimberly, Idaho, horizontally orients bean seeds at uniform soil depths. The researchers worked with Canyon snap beans. Field trials showed that when planted with the precision planter, the beans emerged through soil crusts sooner and in significantly greater numbers than did those planted with a standard two disk planter.

This is exactly why the precision planter could prove so valuable. Viable seeds planted horizontally at precise depths have a much better chance of reaching the surface earlier than randomly planted seeds. Oriented seeds also nearly all start germinating together and may have a week or more head start on the regularly planted seeds. That also means that they mature about the same time, making harvesting dates easier to schedule. Increased yields are attributed to the longer growing period due to earlier emergence, and a more favorable seed environment.

The new planter has a shoe which forms a smooth, flat surface for planted beans. Oblong beans falling on this surface almost always orient themselves horizontally.

To facilitate the orientation, seeds drop from the hopper into a curved tube that enters the shoe at the front and extends to the rear where the bean slides onto the flat soil surface.

Seeds drop—or slide—out of the shoe at about the same speed as the planter is moving forward. Thus the seed is planted at almost zero miles per hour giving it little opportunity to tumble before being covered by soil.

While oriented treatments in three harvests—Aug. 11, Aug. 14, and Aug. 17—produced greater total yields than regular plantings, the differences were not significant in the third picking. This loss of significance in the third picking indicates that standard treatments, given sufficient growing time, would probably equal the oriented treatments in total yield.

Most canneries prefer a single harvest for green beans. The best time for harvesting is determined by field estimates of bean yield and fiber content. Although fiber content was not measured in the experiments, field estimates indicated the second picking to be most suitable for canning. For this picking the total yield of oriented beans exceeded standard plantings by more than a metric ton per acre or 47 percent. Total yield for oriented beans was about 4½ metric tons per acre for the oriented plantings and about 3 metric tons per acre for the regular plantings.

The favorable effects of oriented plantings are not restricted to seed orientation. Average planting depths by the orienting and the standard planters were 2.5 plus or minus ⅛ inch and 2.0 plus or minus ⅜ inch, respectively. The smaller deviation of the oriented beans should insure more uniform emergence because more seeds are planted at the same level. In effect, depth of planting is more precise with the orienting planter.

Although not verified, Clarence W. Hayden, ARS research technician, and Sidney A. Bowers, former ARS soil scientist, say that the rapid emergence of oriented seed may also be influenced by favorable soil moisture. In forming the flat surface the underlying soil is relatively undisturbed. This undisturbed soil may allow a more rapid flow of water to the seed and thus aid earlier germination. □

An agricultural success story

"THE MOST OUTSTANDING ACHIEVEMENT in the virus cancer field in the last decade or two," says Maurice R. Hilleman, Merck Institute for Therapeutic Research, West Point, Pa., of the vaccine developed by ARS scientists against Marek's disease of chickens.

"We have seen a near miracle occur in the control of a disease that just 2 years ago was the scourge of our industry," observes Reed R. Rumsey, Dekalb AgResearch Inc., Dekalb, Ill., in describing the vaccine's impact on the egg production industry.

Poultry industry acceptance was immediate and enthusiastic, says Ben R. Burmester, leader of the team that developed and tested the herpesvirus of turkeys (HVT) vaccine at the ARS Regional Poultry Research Laboratory, East Lansing, Mich. The vaccine was in use within 2 months after USDA authorized commercial production.

Dr. Hilleman's comment was made in a paper prepared as part of contract research for the National Institutes of Health, Department of Health, Education, and Welfare.

"Awaiting the isolation of human cancer viruses," he comments, "probes can now be made using the numerous existent animal models to establish the necessary guidelines and precedents whereby human cancer vaccines can eventually proceed toward development." He notes that researchers will

One-day-old chicks are inoculated with herpesvirus vaccine by Dr. H. Graham Purchase. Specific-pathogen free, these birds will be raised in isolation until they are 3-weeks old. At that time, the effectiveness of the vaccine will be "challenged" by exposing the birds to Marek's disease (0673A1226–25).

find the art and technology of vaccine preparation in a highly advanced state, whenever human cancer viruses are isolated, because of progress already made on vaccines for Marek's and other acute viral diseases of animals.

Speaking at a poultry disease training course at the National Animal Disease Laboratory, Ames, Iowa, Dr. Rumsey pointed out that the HVT vaccine is benefiting consumers through increased efficiency in egg production. He estimates that vaccinated birds are laying 3 percent more eggs than those not vaccinated. Higher egg production and reduced death losses in laying flocks have helped restrict rises in egg prices.

The improved health of laying flocks has encouraged producers to keep birds in production longer, with a marked reduction in the number of replacement pullets. Dr. Rumsey suggests that 8,100,000 fewer egg-type pullets need be raised annually. He also estimates that the Nation's egg requirements can be met with 9 million fewer layers because of higher production by vaccinated birds.

Dr. Rumsey says reducing the numbers of both replacements and layers should save one-half million tons of feed annually. He adds that the use of the HVT vaccine in laying flocks alone should release 100,000 acres for food or feed purposes. This estimate is based on the assumption that 60 percent of the layer ration is corn with an average yield of 100 bushels per acre.

In 1968, 3 years before the advent of the vaccine, more than half of the death losses in poultry and 48 percent of poultry condemnations because of disease at processing plants were caused by diseases of the avian leukosis complex—Marek's disease and closely related lymphoid leukosis. Marek's was responsible for about 75 percent of these losses. In 1965, this disease complex was responsible for only 21 percent of the condemnations.

Assuming that the vaccine has an average effectiveness of 85 percent and that 85 percent of commercial poultry receive it, Dr. Burmester estimates that annual losses from Marek's disease have been reduced about 72 percent.

Dr. Burmester emphasizes that the HVT vaccine "did not happen suddenly from the efforts of one or two scientists but was the new result of a group effort over several years."

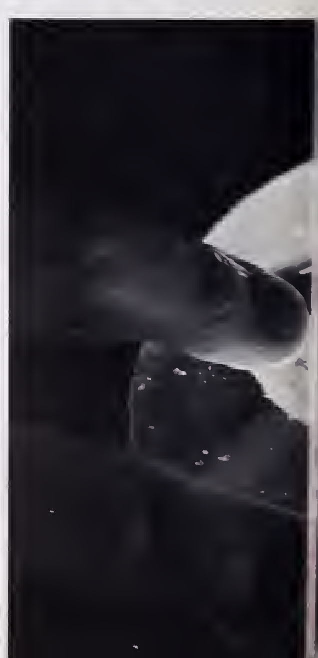
The first and most important advance was the positive identification and isolation, at both East Lansing and Houghton, England, of a herpesvirus as the cause of Marek's disease. Before and concurrent with this step was the development and verification of procedures and reagents that are important prerequisites for developing and testing a vaccine. Dr. Burmester has identified 18 accomplishments of the East Lansing laboratory directly related to development of the vaccine as well as 10 others less closely related.

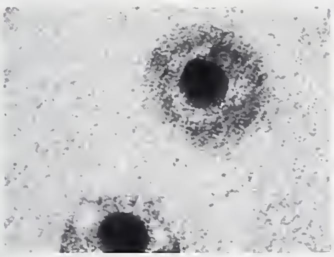
The HVT virus, used as a vaccine, is unusual in that it naturally infects almost all turkeys, yet causes no disease. Further, it is so closely related to Marek's disease virus that it protects chickens against this disease, yet can only be distinguished from Marek's disease virus by serologic procedures.

The East Lansing laboratory, which has been concentrating almost exclusively on Marek's disease, now is devoting about 60 percent of its research effort on Marek's and 40 percent on lymphoid leukosis.

Marek's disease studies are directed toward development of (1) an antiviral vaccine rather than a vaccine that prevents tumors but has little effect on the virus, (2) strains of chickens that are resistant to infection, (3) husbandry methods that will make isolation-rearing practical, and (4) specific antiviral chemicals.

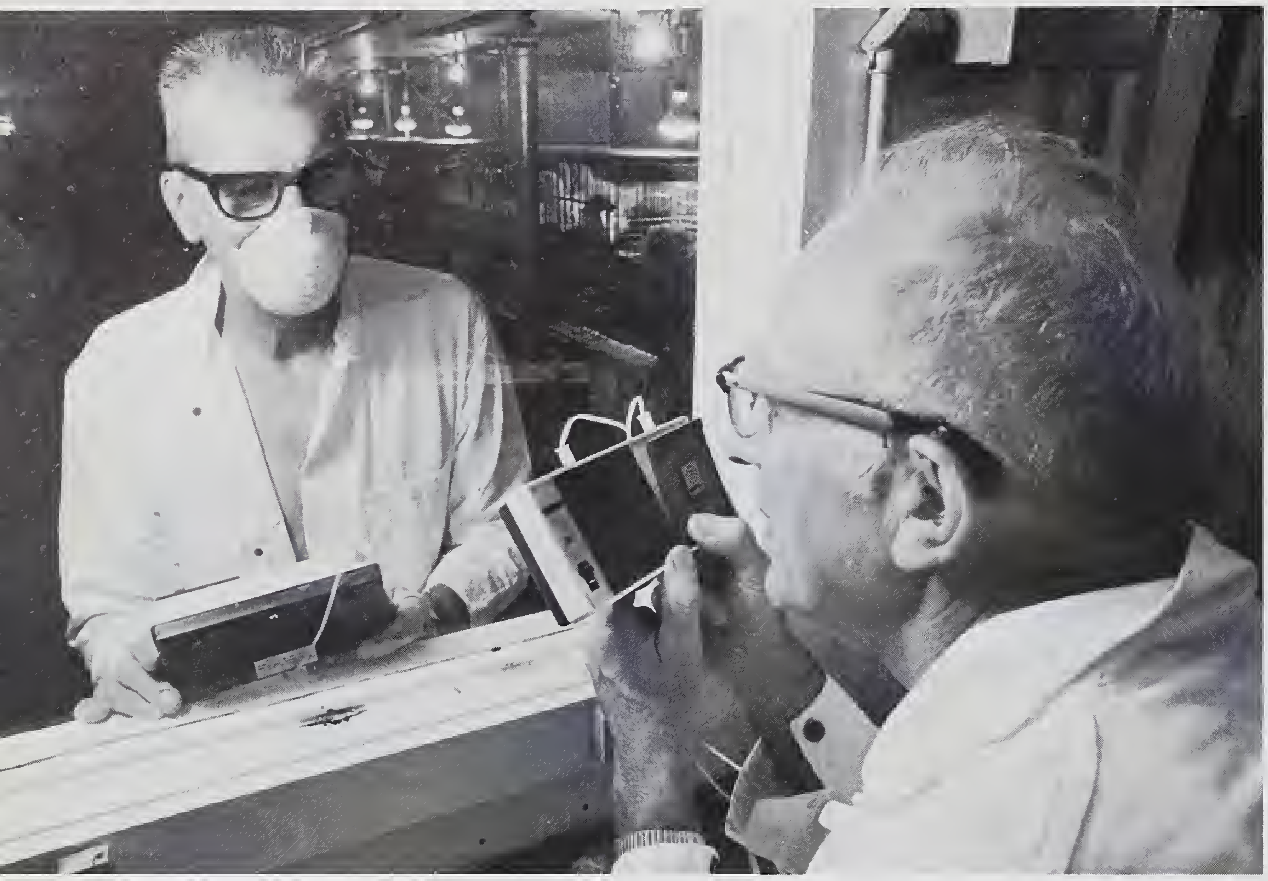
The lymphoid leukosis research is now directed toward developing (1) less costly methods of detecting infection, (2) development of a practical vaccine, (3) study of genetic resistance, and (4) basic investigations of the virus and the mechanism for immunity to the disease. □





Above: *Herpesvirus of turkey vaccine is mass-produced at the laboratory. Here, technicians Rolanda Watt and Maiga Gailitis observe cell growth on the surface of roller bottle. The cells are prepared from 13-day-old duck embryo fibroblasts (0673A1229–25).*
Far left: *Microbiologist Elizabeth A. Hood inoculates the chorioallantoic membrane of 10-day-old embryos to determine their susceptibility or resistance to leukosis-sarcoma viruses. Geneticist Howard A. Stone labels each egg with amount and type of virus inoculated. Fertilized eggs are from specific pathogen-free flocks maintained in isolation (0673A1230–3).*
Left: *Marek's disease virus (MDV) is the causative agent of Marek's disease. The viral particles are present in the infected cells, but only the epithelial cells of the feather follicles of an infected chicken contain the cell-free infectious virus, two of which are shown here, complete with their envelopes (PN–2841).*

Light shining through a stretched chorioallantoic membrane of an embryo reveals the number of lesions induced by inoculation with leukosis-sarcoma virus. This technique enables scientists to determine the genotypes of the embryo's parents—information that will help supply researchers with birds of particular genetic types (0673A1228–7).



Masked against the respiratory transfer of disease organisms, technician Cecyl Ansley talks via two-way radio to Dr. Burmester through the observation window of a pathogen-free poultry rearing house at the Regional Poultry Research Laboratory. This facility is equipped with a positive air-pressure system that virtually eliminates the possibility of infection through the introduction of air-borne particles. The system works by raising air pressure inside the poultry house over that of the outside. In ordinary poultry houses, birds contract disease from one another through air-borne particles. This poultry house, however, has a filter system that removes 99 percent of any virus particles that may be present. Along with these safeguards, all persons entering the facility are required to shower and change into sterilized clothing (0673A1221-6).

Above: *Laboratory technician Barry Coulson records findings as Dr. Purchase performs autopsy on chicken carcasses. All birds that die during an experiment are autopsied, as are those that have survived to the experiment's end (0673A1227-15).* ***Upper right:*** *Dr. Burmester studies tissue culture of Marek's disease (0673A1216-8).*

Right: *Residue from experiments is reduced to water, carbon dioxide and a small amount of ash in this new high-intensity incinerator designed to meet antipollution standards (0673A1229-8).* ***Left:*** *Five-week-old chickens in isolation are examined by geneticist Howard A. Stone. In purpose, the chambers are similar to incubators and also provide a safeguard against infection. Eggs are put into the chambers as 18-day-old embryos; after hatching they are banded to show their specific genetic group, and the chicks are reared to the age of 6 weeks. They are then transferred by portable isolation chambers to larger isolation chambers where they produce fertile eggs for experiments. Dr. Stone is a member of the original team of researchers in this country that first identified and isolated herpesvirus as the cause of Marek's disease. Other members of this team are Dr. Ben R. Burmester, Dr. H. Graham Purchase, Dr. John J. Solomon, Dr. Richard L. Witter, Dr. William Okazaki, Dr. Keyvan Nazerian, and Dr. Lucy F. Lee (0673A1222-14).*

BEHIND THE SCENES:

STEP BY STEP

THE ANNOUNCEMENT in the press of a scientific development normally tells the reader what the development is and what it means to him. This may be all he wants to know. Behind the scenes of most research, however, are many thoughtful and precise steps. In the case of the vaccine against Marek's disease of chickens, a team of internationally known scientists painstakingly initiated and followed 18 steps to the successful development of the vaccine. Because of this, and because research of this type points the way for developing vaccines against human disease, they are listed here in brief form. They illustrate some very fundamental research that is vital to solving perplexing problems. To make the vaccine a reality, the team of ARS scientists at East Lansing:

- Developed and produced a line of chickens that are highly susceptible to Marek's disease.
- Identified microscopic and ultrastructural changes of cells and cell cultures resulting from infection with Marek's disease virus (MDV).
- Applied the immunofluorescence technique for detection and assay of MDV antigen and antibody.
- Detected, assayed, and produced cell-free MDV and herpesvirus of turkeys (HVT).
- Applied the neutralization test and assessed neutralizing antibodies.
- Verified and studied essential requirements of the agar gel precipitin test for MDV antibody.
- Reduced the virulence of MDV and studied MDV properties.
- Studied in depth the epidemics of Marek's disease and isolated herpesvirus from turkeys.
- Made comparative studies of antibody production of MDV and HVT.
- Detected surface antigens in cells infected with MDV.
- Made a comparative study of the pathogenicity and antigenicity of virus clones from strains of MDV and HVT.
- Determined the effect of vaccination on the spread of MDV from bird to bird (horizontal spread).
- Developed capability for large-scale production of MDV.
- Determined the susceptibility to MDV and HVT of cell cultures of various avian species.
- Evaluated the response to exposure (challenge) with MDV at various intervals of time after HVT vaccination.
- Established storage requirements and procedures for HVT vaccine.
- Demonstrated that HVT does not produce disease in turkeys.
- Developed the multilayer cell culture technique to improve yields of HVT vaccine.

Trial by burning is the fate of miniature peanut hull and wax (right) and wood chip and wax fireplace logs in laboratory experiments. Here, chemical engineer William Albrecht analyzes the tiny logs for burn vigor, burning time, and ash content (0873X1319–29).

12-13

Peanut hull logs warm the hearth

PEANUT HULLS have come out of the ecological doghouse and into the livingroom. Plagued by smoke and fly ash from large hull-burning incinerators, the peanut shelling industry has a chance to trade air pollution for a new source of profit.

Cattle feed, poultry litter, and garden mulch utilize part of the 350,000 tons of hulls produced annually, but the excess is burned near the shelling plants, usually in rural or small urban communities. Authorities are demanding safer methods of disposal.

In ARS studies at the Russell Research Center in Athens, Ga., the combustible, absorbent peanut hulls were ground, mixed with waxes, and made into artificial fireplace logs. Laboratory and home fireplace experiments conducted by chemical engineer William J. Albrecht, and research chemists Franklin E. Barton, II, and Donald Burdick, showed that the peanut hull logs compared favorably with commercial logs now on the market.

Slack and scale waxes (hydrocarbons) used in the commercial manufacture of artificial logs were combined with peanut hulls for direct comparison of wood and hull fillers. The researchers prepared 2-inch-long minilogs from 14 peanut hull formulations involving different combinations of waxes and additives and two commercial logs. Their evaluations included shear strength (a measure of strength determined by the capacity to resist cutting), ease of ignition, burning time, and flame height. Two peanut hull logs made with two different slack waxes proved to have triple the shear strength of all logs tested. They showed normal burning time, superior ignition properties, and exceptional maximum flame height.

Fuel-size peanut hull logs, 16 inches by 4 inches in diameter, made with these waxes and two brands of commercial logs were then burned in home fireplaces. The commercial logs burned 4 hours compared to 3 hours for the peanut hull logs, but the experimental logs burned more vigorously. When a salt mix was added to the formulation, hull logs burned with a blue-green flame with occasional red flares. The experimental logs were easier to ignite, odorless, and gave little smoke.

Artificial wood-filled fireplace logs are currently selling from 90 cents to $1

each. At 0.5 cent per pound for hulls and 4 cents per pound for wax, raw material for peanut hull logs costs 17 cents per log. Equipment, labor, and overhead would add to this cost, but the current retail price of the competitive logs makes commercial manufacture of peanut hull logs economically attractive.

"Using a salt mixture for coloration increases the cost by 4 cents per log," adds Dr. Barton.

Even so, the lowly peanut hull may become a fireplace favorite. More important, its use in fireplace logs looks like a winning round in the fight for a cleaner environment. □

Above: Differences in the texture of miniature logs made of peanut hulls and wax (left) and wood chips and wax (right) are noted by research chemist Franklin E. Barton II. The peanut-wax log is smoother, looks better when burning, and responds more like a typical log than does the wood chip-wax log (0873X13197). ***Below:*** *Commercial size peanut hull-wax logs warm these fireplace sitters (0873X1321–10).*

Crossbreeding with Finnsheep

PROLIFIC FINNSHEEP can probably make their greatest contribution to productive efficiency in the sheep industry when used to sire crossbred ewes for market lamb production.

In comparisons of Finnsheep crosses and Rambouillet crosses at the U.S. Meat Animal Research Center, (MARC), Clay Center, Nebr., Finn-cross ewes were mature enough for breeding at an earlier age, had higher lambing rates, and lower lamb mortality during the first 10 weeks. Early growth of the lambs equalled that of lambs produced by Rambouillet-cross ewes.

The studies were directed by geneticist Gordon E. Dickerson, former nutritionist Hudson A. Glimp, and MARC director Keith E. Gregory, all of ARS, in cooperation with the Nebraska Agricultural Experiment Station, Lincoln.

In the first phase of the research, the scientists compared viability, growth, and carcass traits of nearly 1,200 Finn-cross and more than 500 Rambouillet-cross lambs out of Suffolk, Hampshire, Dorset, Rambouillet, Targhee, Corriedale, and Coarse Wool synthetic ewes and more tha 1,900 straightbred lambs of these breeds (AGR. RES., Feb. 1973, p. 16).

Lamb mortality for the Finn-sired crosses during the first 10 weeks was about half that of Rambouillet crosses, and less than half that of purebred lambs. Finn crosses were smaller at birth, equalled or exceeded Rambouillet crosses at weaning (10 weeks) and at 18 weeks, but grew more slowly after 18 weeks.

Crossbred ewe lambs produced in the first phase of the studies were raised in drylot and bred to Suffolk, Hampshire, and Oxford rams for lambing at 1, 2, and 3 years of age.

When bred first at 6 to 8 months of age, 315 Finn-cross ewes exceeded 206 Rambouillet crosses by these percentages: 85 versus 66 in fertility, 159 versus 111 in lambs born per ewe lambing, and 131 versus 69 in lambs born per ewe bred. Finnsheep crosses had no advantage in fertility when bred as yearlings or 2 year olds, but their lambing rate was higher than that of the Rambouillet crosses by 60 born per 100 ewes lambing at 2 years of age, and 16 born per 100 ewes lambing at 3 years.

Under adverse early spring lambing conditions, the net advantage of Finn-cross ewes in percent lambs weaned for ewes lambing was only about 17 percent for yearlings, 19 percent for 2 year olds, and 12 percent for 3 year olds. The primary problem in taking full advantage of the reproductive efficiency of Finnsheep, Dr. Dickerson explains, is to provide the level of nutrition and management of ewes and lambs necessary to produce and raise twin, triplet, and quadruplet lambs.

Finn-cross market lambs finish at lighter weights than Rambouillet-crosses, dressing 2 to 3 percent higher but with more kidney fat and lower estimated yields of boneless or trimmed cuts as percent of carcass weight. □

Altering growth rate through selective breeding

DISCOVERY of a genetic trait in laboratory mice may have significance for livestock breeders if they want animals with the ability to grow rapidly and mature early.

ARS animal geneticist Stanley P. Wilson demonstrated, for the first time in mammals, that growth curves can be altered through selective breeding. Growth curves are graphic representations of growth plotted against time. Mice were chosen for the experiment because, in addition to being mammals as are domestic livestock, they are small and they produce new generations often.

The studies were conducted in cooperation with the Purdue Agricultural Experiment Station, Lafayette, Ind.

In an earlier study also having implications for livestock breeders, 84 generations of mice were raised. ARS scientists proved that the size of mice reaches a plateau after continuous and repeated selection for largeness (AGR. RES., Feb. 1972, p. 7).

During the recent growth curve study, Dr. Wilson raised groups of selected mice, or breeding lines, through eight generations. The mice were weaned and weighed at 21 days of age. They were also weighed at 42 and 63 days. For line 1, Dr. Wilson selected mice that gained the most weight during early postweaning (21–42 days). For line 2, Dr. Wilson did not select for weight gains per se. Rather, he selected mice that attained the highest percentages of their total postweaning gains during the early postweaning period.

These percentages trended higher with successive generations of line 2—about a 10-percent increase by the end of the experiment. The growth curves shifted, not because of any appreciable changes in early postweaning gains, but because late postweaning gains decreased. Having been selected to make the most of their postweaning gains early, line 2 mice matured early as one might expect.

Growth curves of line 1 mice did not shift, Dr. Wilson said, because even though early postweaning gains increased, later gains also increased. Both lines matured earlier sexually than control mice, apparently as a result of repeated selections, Dr. Wilson said.

Line 2 mice had a low heritability trait for achieving high proportions of their postweaning gains early (about 10 percent). Through succeeding generations the rate of change of these proportions was slow even with intensive selection.

The experiment indicates that livestock could be selected for growth rate without necessarily increasing adult body size, Dr. Wilson said. Other studies have shown that early maturing female cattle, having larger gains from weaning to about 2 years of age, also have smaller mature weights than late-maturing females. However, if large, late-maturing animals are preferred or unobjectionable, selection for early gain alone—as in line 1 mice—would be the best method for breeding animals to reach market weights rapidly. □

AGRISEARCH NOTES

Narrow row spacing for sugarcane

PROBLEMS in growing sugarcane are like the mythical nine-headed Hydra—cut off one head and two grow back. For example, breeders have achieved higher sucrose per ton of cane by selective breeding, but how can growers increase the yield per acre?

One answer lies in row spacing. Rouby J. Matherne, agronomist at the U.S. Sugarcane Field Station in Houma, La., has broken with the widespread practice of planting 6-foot-row widths. Comparing the average yields of cane per acre using 3-foot-row widths and 6-foot-row widths, he finds that the narrower the row, the higher the yields. More cane can be harvested from the same acreage by planting the rows closer together.

In a 3-year experiment, planting both 6-foot and 3-foot rows, Mr. Matherne increased the tonnage per acre in the narrow rows by 38 tons. This is an average of 13 tons per acre per year. Using $10 as an approximate price for 1 ton of cane, the farmer's pocketbook would be fattened by $130 more per acre every year.

Wider rows were necessary in the past for adequate drainage, and 6-foot rows required harvesting equipment suited for this wide spacing. However, engineers and agronomists have used crowning (slightly elevating the center of the plot) and ground leveling to help solve the drainage problem.

Further research would involve changes in present equipment to adjust to narrow row planting. Perhaps this is another head of the Hydra, but it is also a possibility for increased profit.

At right is the black G-R pig, termed the "ideal" pig for research as compared with one of the currently used "miniature" pigs. The pigs are the same age and both have had litters (PN-2844).

The ideal research pig

THE "IDEAL" PIG for swine research has been found. It is derived from the nearly extinct breed called the American Essex.

Several lines of "miniature" pigs have been developed and readily accepted in medical research. However, experience has shown that these "mini" pigs generally have one or more shortcomings. They are either rare and hard to get, do not adapt well, do not like to be confined in small areas, and as important as anything else, most are mean and intractable.

By contrast, the new line, named the Greer-Radeleff (G-R) pig, adapts well to small pens after freedom on the range, and is extremely docile, a major consideration in research that requires frequent handling. A small herd has been established at College Station, Tex. Veterinarian Harry E. Smalley is in charge of the herd.

The G-R pig is economical to feed, weighs only 40 to 50 pounds at 6 months and about 160 pounds at 2 years, about the same as the "mini" pigs derived from such exotic lines as the Yucatan, Vietnamese, and Corsican pigs. At 3 and 4 years of age, however, "mini" pigs generally gain weight more rapidly and soon weigh as much as 25 percent more than the new line.

The G-R pig breeds readily, has normal gestation length, farrows easily, and has smaller litters than standard breeds. It has normal hematological and biochemical values. It appears to have become, through isolation in nature, specific pathogen free, ectoparasite free, and troubled only by an internal parasite—the roundworm.

The new line was named the Greer-Radeleff pig after the owner of the parent stock, J. Leo Greer, Rock Springs, Tex., and Rudolph D. Radeleff, ARS veterinarian who initiated the project and conducted the long search for the right animals.

The herd is now being increased and maintained at College Station.

UNITED STATES GOVERNMENT PRINTING OFFICE
PUBLIC DOCUMENTS DEPARTMENT, WASHINGTON, D.C. 20402

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AGRISEARCH NOTES

The quest for a good cantaloup

IN SPITE OF a test that's been around for 50 years, there may not be a reliable way of telling how good a cantaloup is short of actually tasting it.

The test is an estimate of sugar content arrived at by measuring the soluble solids content of the melon. USDA and some State inspectors still go by this. But a 3-year study indicates that a cantaloup with a soluble solids content of at least 11 percent (U.S. Fancy) or 9 percent (U.S. No. 1) may not always be sweet and flavorful.

Food technologist Barbara B. Aulenbach and horticulturalist John T. Worthington, Agricultural Marketing Research Institute, Beltsville, Md., have found that results of taste-panel tests for sweetness were not highly correlated with refractometer measurements for soluble solids.

The soluble solids content of cantaloups does have some relationship to their sweetness. If the value is less than 9 percent, a lack in sweetness can be expected. In this study, however, correlation coefficients between the objective measurements and sweetness by taste were only between the 0.6 and 0.7 range. This suggests the need for a critical look at soluble-solids measurements as indicators of consumer quality in cantaloups.

Before the scientists recommend changes in inspection procedures, however, they will have to perform consumer-type tests with many more samples than were used in this study.

Semidwarf durums may resist lodging

SEMIDWARF durum wheat varieties, which should resist lodging under intensive management, are a step closer to development.

Genes derived from the Norin-10 variety are responsible for the shorter, stiffer stalks that make semidwarf wheats less likely to lodge than taller varieties. Unfortunately, lower kernel weight and test weight (weight per bushel) are also associated with the Norin-10 genes in semidwarf durum breeding lines as they are in semidwarf bread wheats.

Geneticist Leonard R. Joppa, in experiments at Langdon and Fargo, N. Dak., found that kernel weight and test weight are, respectively, 77 and 80 percent heritable. Consequently, breeding durums that are acceptable in both characteristics should be possible by selecting as parents those lines that have large seeds and high test weight.

Dr. Joppa compared agronomic characteristics of tall and semidwarf breeding lines developed from common sources. They had been selected for good agronomic type and disease resistance and had been segregated for height in the fifth generation.

He found that the semidwarf genes lowered average kernel weight and test weight and perhaps lengthened days to heading. The semidwarf lines averaged 13 inches shorter and had more seed-breading stalks than the tall lines. Lodging was not a problem in these studies, and under conditions in the studies, the semidwarf genes did not affect yield.

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